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----- N U T C R A C K E R N O T E S -----

A Research and Management Newsletter about Whitebark Pine Ecosystems

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This issue of **NUTCRACKER NOTES** contains mostly articles on the importance of genetics in restoration projects. Included are whitebark pine seed zone criteria and the genetic implications of restoration. Many of the same features are continued in this issue. *Whitebark Pine Success Stories* are brief summaries of planned and completed management restoration projects. *Whitebark Tidbits* is a section for those who don't want to write an extensive article, but feel they would like to report some information concerning whitebark pine ecology to the editor via email. As usual, your comments, and more importantly, your articles are fervently requested... The editor.

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A WHITEBARK PINE EDITORIAL

Whitebark Pine Ecosystem Restoration: Roadblocks to Implementation

by

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I was a silviculturist for over 10 years on the Bitterroot National Forest and one of the many tasks I was assigned was to develop plans to restore whitebark pine to the high elevation landscape. This was one task that I enjoyed, but it also gave me great frustration. Here are some of the major roadblocks I've experienced in implementing whitebark pine restoration efforts.

One of the biggest problems with applying fire to restore whitebark pine ecosystems is the narrow prescribed burning window. Historically, these ecosystems burned in late summer, early fall; a time when prescribed burning is nearly impossible in present-day circumstances. A later burning window, usually late September, early October, is more feasible, but a hard frost is often needed to kill shrub foliage to provide fine fuels for ignition and fire spread. Then a few days of dry weather is needed to dry the larger fuels so adequate intensities are generated. Unfortunately, the frequency and timing of these events can be very elusive. We had problems on the Bitterroot getting even a late September window because the lower ponderosa pine type would either still have fires going in a good year or at least be at a moderate-to-high fire danger rating. So our burns kept getting delayed because the district rangers didn't feel it looked right or felt the burn was too risky.

And then there are problems with smoke dispersion in the fall. This one factor can easily delay burning for days, and sometimes weeks. This barrier can even become larger depending on air-shed. Those restoration projects in whitebark pine stands that are near the Missoula or in the Flathead valley air-sheds will tend to have a much shorter burning window because of air quality problems. Spring burns, when there is often good dispersion, aren't realistic given late snowmelt, rapid herbaceous greenup, high fuel moisture, and so on.

Another problem we had on the Bitterroot was that most projects were either in wilderness (i.e., hands off) or right next to it. Some district rangers were concerned the prescribed fire would slop over into wilderness, and the perception from the public was that we were intentionally trying to get something going in wilderness. Moreover, if the fire did enter the wilderness, the cost of putting it out was enough to prevent prescribed burning on our restoration project areas adjacent to wilderness. And of course, this was also true of all roadless lands that were potential wilderness. We had to bat that one around in NEPA quite a bit. And with the new roadless policy proposed by the Clinton Administration, it could make things even messier for whitebark pine. Of course, if National Forests don't have a lot of wilderness, or if their wilderness areas are not closely watched by Wilderness Watch or the Wilderness Society, they probably won't have any problems, but nothing is ever that easy on the Bitterroot National Forest, or any National Forest for that matter.

Another problem we experienced was the anxiety that some fire management officers (FMOs) had

over burning in these upper subalpine types. Most were not familiar with the vagaries of prescribed burning in whitebark pine, and, more importantly, some did not like the high risk associated with doing a partial stand replacing/severe burn that is often needed for restoration. This caused some real discomfort among FMO's, but once we got the first burn going, and the big subalpine firs were going up in flames right and left, they found it wasn=t as bad as they feared. Since most whitebark pine stands are in remote areas with limited access, some FMOs are reluctant to conduct prescribed burning in stands where the full range of fire control options are not available. It=s unfortunate, but many FMOs worry about the criticism from both inside and outside the agency about whitebark pine burns where many feel that we are taking unnecessary risk burning these types. So the biggest thing we can do is rally behind FMOs and provide them with the information they need to successfully implement the burn.

Additionally, there is a common perception among fire staff that their efforts should be centered on the lower elevation, higher fire frequency types (i.e., ponderosa pine-Douglas-fir) that have more risk to humans (urban interface). It=s really an up-hill battle to convince them that these upper subalpine types with introduced diseases and declining populations also need treatment. Wildlife bios and ecologists are badly needed to make the case for restoration in whitebark pine. FMO's are rewarded for putting fires out and keeping prescribed burn costs down and not taking too much risk. Ironically, many suppressed wildfires originate in whitebark pine, and burning costs and risks are a little greater in these ecosystems. So, burning in whitebark pine doesn't help FMO=s get kudos or high performance ratings. We need to figure out how to reward them for being progressive.

Successful restorations projects need to be highly integrated with wildlife, hydrology, aquatics, and fire. Silvicultural prescriptions must design wide ranges of acceptable mortality to give the FMO's room to stretch, actually implement and learn - and because the burn regimes in these types were historically highly variable in space and time anyway. Also, they are going to have to be pretty non-traditional in their approach to treatment. In designing restoration treatments, I used to try to call things according to traditional forestry terms, such as group selection and thinning. However, the real treatment doesn=t lend itself to be pigeon-holed into silvicultural harvest systems designed to remove timber volume rather than restore ecosystems. Something just don't fit well so might have to resort to inventing your own terminology.

Another real concerns of some silviculturists is that we might be messing it up more than just letting the disease run its course. The feeling is that we might be burning up what few resistant genes we have out there. And that's a good point. That's why I tried to take pains to ensure the survival of as much live whitebark pine as possible. I think it's going to depend on how bad the rust is in their stands - if it's killed off everything else, then obviously you need to protect what survivors are left, at any cost (slash pull back or leave green patches around them, whatever). If it's a light to moderate infection level, you have a little more leeway. It all depends on the big picture, too - how much they whitebark pine stands are available, how bad rust is in that area, public and wildlife issues, budget constraints, and support from the line officers.

Funding was always a big problem on the Bitterroot. We were lucky to have BEMRP (Bitterroot

Ecosystem Management Research Project) to help us out and provide some limited funding. And the fact that the researchers were involved and willing to do the monitoring for us, helped give it support. The fire folks were reluctant to use any fuels dollars toward whitebark pine restoration (due to high costs relative to PP type and that the focus should be lower elevation), but because of the research focus, we ended up funding some of the burns with fuels monies. There is a new Whitebark Pine Ecosystem Foundation that might help in future. The only other thing we can do is try to get fire management in Regional Offices to support more of this. It's in the Chief's resource agenda - but as another one of those unfunded mandates. There are probably other grant sources if one has time to look and apply. Sometimes if you have access, timber sales can help.

Whitebark pine restoration is possible and can be highly successful. It=s one of the few, true Awhite hat≅ projects that we can do on the landscape. Overall, the roadblocks to implementation can eventually be overcome, but it will take commitment, patience, and a thick skin.

MANAGEMENT NEWS AND NOTES

Whitebark Pine Restoration Strategy -- Some Genetic Considerations

by

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Rationale -- An effective restoration strategy in whitebark pine should include components related to patterns of genetic variation in this species and particularly, genetic resistance to blister rust. Our restoration efforts may be hampered if we assume that whitebark pine has the same response to blister rust as does white pine. When there is an exotic pest problem, a restoration strategy must include elements that address the biology, ecology and genetics of the host, as well as the pathogen.

This proposal emphasizes the biology and genecology (genetics + ecology) of the host (whitebark pine), with a modest emphasis on the biology and ecology of the rust. Projects suggested in this proposal would also provide required information to initiate a selective breeding program in the future. The suggested strategy includes 1) elements that are on-site (*in-situ)* e.g., working directly with native populations, and 2) off-site (*ex-situ*) considerations when there is a high risk of losing a species (e.g., cataloging and storing biologic materials at a seed and pollen bank or nursery).

Background -- Because the loss of cover type is so pronounced, in the absence of successful regeneration, efforts to increase whitebark pine communities run a high risk of failure if only thinning and prescribed fire are utilized exclusively to restore this species. Efforts to promote vigorous stands using these techniques in white pine have increased blister rust infection (opening up stands=>more light=>more *Ribes* plants=>more infection) (Schwandt et al. 1994). Without sufficient blister rust resistant seed available on site, natural regeneration also runs a high risk of failure due to the unique seed dispersal and cone caching by Clark's nutcrackers and red squirrels.

But how successful will our efforts be if we take a hands-off approach (i.e., natural regeneration)? No restoration strategy emphasizing natural or artificial regeneration is likely to be successful, if there aren't meaningful levels of genetic variation in adaptive traits (e.g., survival, growth rhythm, disease resistance) in the native communities. A biologic and economic rule-of-thumb for judging success in developing blister rust resistance, is that no less than 5 percent of the total variation be present among individuals in a controlled experiment, such as a rust screening. Said another way, if there aren't some differences among individual trees, it is hard to pick the better performing trees from the poorer performers. We need to know if there isn't at least that much variation in blister rust resistance, because it will be difficult to restore whitebark pine communities using natural or artificial regeneration as effective tools.

Suggested Projects -- Blister rust resistance in native populations of whitebark pine can be inferred indirectly or directly. Little or no funds have been made available to develop an inventory of

whitebark pine communities. Sketchy information on a few populations of presumably blister rust resistant whitebark pine are available, but the information is anecdotal in nature.

A low-tech approach to infer blister rust resistance would be to field inventory and attach rust infection levels to whitebark pine communities across the region. Those communities at moderate risk could then be targeted as most likely to succeed for rehabilitation via prescribed fire, planting of seedlings, and thinning. Communities with high blister rust infection (e.g., greater than 50 rust-free trees per acre) could also be cultivated as seed collection stands, helping to accelerate natural selection for blister rust resistance by using these leave trees for cone collections for future plantings.

Prescribed fire and thinning could also encourage natural regeneration in high infection areas, favoring individuals with naturally developed resistance, but much trial and error would have to occur before an adequate prescription could be tailored to fit each stand, because too much thinning and fire could likely increase *Ribes* populations. An assessment of Clark's nutcracker and squirrel-cached seeds (seed count, seed viability, etc.) and cone crop forecasts would also be needed to justify natural regeneration over artificial regeneration.

An additional on-site strategy could include identifying and designating permanent leave-trees across the native range of whitebark pine, much like our white pine blister rust resistant plus tree program. Presumed blister rust resistant individuals would be identified per each administrative unit, to broadly sample the genetic base (to conserve genetic diversity across the landscape), but to also provide known sources of blister rust resistant seed donors that could be cultured for cone collections, as well.

Early genetic studies in non-adaptive traits (isozymes) point to low levels of genetic variation among and within-stands of whitebark pine (Bruederle et al. 1998, Jorgensen and Hamrick 1997, Lanner 1982). If this trend holds true for disease resistance and survival, any of our efforts (natural or artificial regeneration) are likely to be unsuccessful in high infection areas. But since isozymes and adaptive traits generally are not a one-to-one correspondence in conifers, let's assume there is some genetic variation in blister rust resistance. This assumption isn't too far fetched as we aren't down to five or fewer total communities region-wide, and on a small sample of whitebark pine grafts, retired scientist Ray Hoff RMRS, found 44 percent resistance in his pilot study (unpublished data).

A rust screening would let us know how successful our restoration efforts would be, by identifying the amount of genetic variation present in survival and disease resistance, while quantifying how much of that variation occurs among or within-stands (stand=population or local community). Second, we would also know which of the seed lots tested are most resistant to blister rust. This information could be cross-referenced with field inventories to prioritize those communities that are most likely to survive by our intervention. Lastly, results of the rust screening would serve as the foundation to develop seed transfer guidelines to ensure our success in planting whitebark pine and to facilitate deployment strategies by resistance mechanism(s). This strategy of utilizing patterns of

genetic variation and deploying more than one resistance mechanism on any given acre makes it highly unlikely a new, more virulent race of rust will develop in planted stock (Mahalovich and Eramian 2000).

Little is known about specific races of blister rust in the Inland West. One noteworthy exception is the identification of yellow and red-spotting races occurring on western white pine (McDonald 1978), with one type not necessarily more virulent than the other. An effective rust screening would also need to include an inoculation that is tailored to whitebark pine. This makes sense in that there is a slightly different mix of *Ribes* species in whitebark pine communities (*Ribes lacustre*, *R. viscosissimum*, and *R. montigenum).* Infected *Ribes* leaves used in the inoculation should also be treated with aeciospores collected from cankers on whitebark pine, in the event there are different rust populations in whitebark and western white pine communities. The alternative would be to use leaves from *Ribes* plants that are not necessarily found in whitebark pine communities, which have been treated with aeciospores collected from western white pine cankers. Given the scattered nature of *Ribes* plants at high elevations, erratic environmental conditions from year-to-year, and possible differences in using infected *Ribes'* leaves tailored to western white pine, the best approach is to develop a *Ribes* garden tailored to whitebark pine.

Special note: the Northern Region, through a special partnership among the Genetics and Wildlife Programs and the Coeur d'Alene Nursery, were able to proceed with a blister rust screening and *Ribes* garden expansion, beginning in 1999.

After completion of the rust screening, seed orchards could be established by collecting scion (branches) from parent trees in the native stands that were from high-ranking sources identified in the rust screening. Until these orchards reached reproductive maturity (about 8 to 10 years after grafting), these high-ranking stands could also be easily marked as cone collecting areas for planting efforts.

A clone bank of promising survivors from the rust screening could also be established at an administrative site, to facilitate future technologies and efforts to restore dwindling whitebark pine communities. Though not in our life times, this clone bank could serve as an operational cone collection site.

Another approach includes storing enough seed in a bank to catalog the natural variability of the species across its range, to facilitate future efforts to reconstruct this species. The seed bank approach currently may not be a viable option with whitebark pine because of our inability to store seed beyond 4-5 years. There are efforts underway however, to study the special germination and seed storage requirements, to make a seed bank a more promising conservation tool in the future.

An *ex-situ* restoration strategy should also include pollen collection and establishment of a pollen bank. There are no known problems with pollen viability over the long-term with whitebark pine. If someone thinks this is a crazy addition to a restoration strategy, check out Zoo programs for threatened and endangered species, as they typically have a sperm bank for their target species.

Lastly, centralizing biologic materials at a federal nursery such as Coeur d'Alene (e.g., seed bank, pollen bank, rust screening trial) and other Northern Region tree improvement administrative sites (e.g., clone bank, seed orchard, *Ribes* garden) would serve as a catalyst to focus restoration efforts among interested partners, as the technology, trained personnel, and equipment are already in place.

Summary -- The purpose of this restoration strategy is to highlight the need to incorporate genetic considerations into a comprehensive strategy to restore white bark pine communities and to provide a list of projects that others can evaluate and prioritize in order of importance, based on the needs of their agency or organization.

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Whitebark Pine Operational Cone Collection Instructions and Seed Transfer Guidelines

by

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Selection of Resistant Whitebark Pine in Natural Stands

In uniform stands of whitebark pine with confirmed mortalities of at least 90 percent, selection of resistant trees is not a problem. In fact, all the remaining trees, even though infected, probably have some level of resistance. In stands such as these, select all individuals that have no cankers--as determined with binoculars. If no trees without cankers can be found, select trees that have no more than five cankers. In stands with 50-90 percent mortality due to blister rust, select individuals with no more than five cankers.

Make no selections in stands with less than 50 percent mortality by blister rust. The first generation of natural selection has just not progressed far enough in order to select resistant trees with confidence. Keep the stands in mind however, as in 5-10 years, mortality will increase. The problem will be to select trees in scattered, non-uniform stands. In these stands, try to get some kind of idea of the level of mortality by blister rust and select as above.

Individual-Tree Selection Criteria for Whitebark Pine

Tree Condition -- Target trees should be bearing 10 or more cones (as an indication the tree has reached reproductive maturity) and selections should be made only from those trees free of disease (e.g., blister rust) or insect (e.g., mountain pine beetle) problems. If quality is important, avoid trees with forked tops and/or steep-angled branches, as these are highly heritable traits in pines. Look for presence of spent pollen catkins in neighboring whitebark pine (to ensure a good pollen cloud to minimize collection of selfed seed). And, to avoid additional inbreeding concerns, do not collect cones within 200 feet of another collection area.

Form -- Though no information is available on a genetic component to krummholz (alpine or prostrate) or erect (subalpine) tree forms in whitebark pine, where possible, collections should be balanced between the two types.

Age -- Any, see cone condition below.

Cache Collection -- *Least* reliable collection method for managing inbreeding in planting stock. Germination ages and seed counts are also less in cache collections (hard to know how long cones have been tucked away, see cone condition and cone ripeness, below). Cones that have come in contact with forest soils may also be disease vectors, creating pest management problems in the nursery (e.g., *Fusarium* sp.). Individual-tree cone collections are superior. If cache collections are used however, collect from: 1) no less than seven caches in a collection area yielding 200 to 300 cones, 2) only collect the current year's cones, and 3) rotted or partially eaten cones should also be avoided.

Cone Condition -- Before collections begin in individual-tree or cache collections, several second year cones should be sampled throughout the crown or cache, respectively, then cut open to evaluate the cut-face for the presence of seed and for degree of ripeness. Many past cone collections have resulted in no seed extracted at the nursery because the cut-face wasn't evaluated for the presence of seeds (i.e., old cones were collected).

Cone ripeness is determined by percent of embryo length in the cavity. In whitebark pine, acceptable germination rates are achieved with a 75 percent or greater filled cavity. If cones are left to ripen on the tree to achieve a 90 percent filled cavity, they will need hardware cloth to protect them from the Clark's nutcracker and red squirrel. Cone protection (wire cages, discussed below) should be applied during June and July, but no later than August 1st of the cone collection year. Seed are usually ripe after August 15th.

Biology of Whitebark Pine Cones and Pollen Catkins

There is some confusion in identifying whitebark pine from limber pine. The surest method is in cone identification. Whitebark cones are 2-3 inches long and limber cones are 3-8 inches long. Whitebark cones are purple and turn dark brown and don't flare when mature. Limber cones are green and turn grayish brown and flare when mature. Refer to the 1989 B.C. Guide to Collecting Cones for color photographs. The strobili (seed cone flowers) of whitebark pine are purple, whereas the strobili of limber pine are green. Pollen catkins are hot pink in whitebark pine and yellow in limber pine. The interval between large crops of whitebark pine is 3 to 5 years.

Whitebark pine has a two-year cone. Conelet surveys can be made the season before the cones are collectible. Snowmobiles could provide quick and easy access to the collection areas for conelet surveys. You should check to make sure the area has no snowmobile restrictions first.

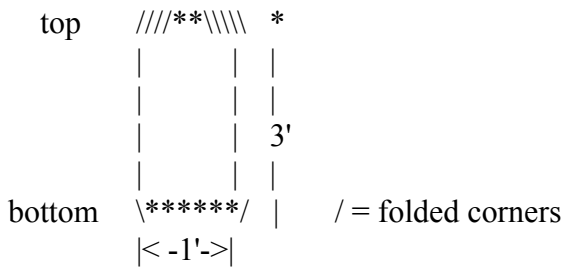
Cone Protection from Predation

Predation of whitebark pine seed is intensive by the Clark's nutcracker and red squirrel. In years when the cone crop is small, predators will consume the entire crop and cache the seed and cones. Red squirrels will cache the cones in middens. Clark's nutcrackers will peck the cones open on the tree and extract the seed and store them in small seed caches on the ground. Squirrel middens may contain cones from several years or just one. They sometimes clean out the midden in July and fill it with that seasons' cones starting in August.

In order to collect ripe seed that has not been protected with hardware cloth or wire cages, from squirrels or birds, frequent monitoring of their activity will be needed so that collection starts at the latest date and before the animals have started harvesting a significant portion of the crop.

Wire cages can be made from 1/4-inch square sheets of hardware cloth (type of wire often used in the construction of small animal cages). With wire cutters, cut a rectangular piece two feet by three feet. Fold in half (1-foot by three feet). Crimp the open side (3-foot length) to make a seam. Fold over each corner to make a tube to slip over a cone-bearing branch. Fold the corners over far enough

on the top of the tube (branch tip) so that birds cannot get to the cones from the top. Adjust wire cage dimensions to fit branch size. Be sure to allow enough room for cones to grow and ripen and be out of beaks-way.



If necessary, secure the wire cage to the branch with fasteners to ensure that it doesn't slip off or blow off in the wind. In north Idaho, wire cages should be placed over the second-year conelets as earlier as June, to protect them from bird predation. In other parts of the region, the wire cages can be installed in July on second-year conelets. An previously constructed cone cage is available from Rocky Mountain Research Station, to serve as a template to make your own. Contact Mary F. Mahalovich by sending an e-mail message to mmahalov/rmrs_moscow@fs.fed.us. Please provide your name, full street address (no P.O. Box numbers) and telephone number.

Grizzly bears also depend on whitebark pine seed during the cone collecting time of the year. Cones are typically taken out of the squirrel middens. Proper safety precautions should be followed while working in occupied grizzly bear habitat in order to avoid any negative human/bear confrontations.

See additional cone collection information in the 1997 Skills For TI Personnel Training Notebook (available from Mary F. Mahalovich, FSL Moscow) or check the newly revised FSH 2409.26f Seed Handbook for Regions 1-4, due out in 2000.

Seed Transfer Guidelines

Whitebark pine is expected to share similar adaptive strategies as western white pine; otherwise considered a generalist, with broad seed transfer both elevationally and geographically. Ray Hoff has already noted similar resistance mechanisms in a small study of whitebark pine grafts inoculated with blister rust. It will almost be another decade before managers have information in hand on the patterns of genetic variation for adaptive traits and blister rust resistance. What we know from isozyme studies (Bruederle et al. 1998, Jorgensen and Hamrick 1997, Lanner 1982) is that this species has *little genetic diversity.* Not only are there few differences among stands or provenances (like western white pine), this species has very little diversity *among individuals* within a stand. If this trend holds with adaptive traits, this species will be even more of a generalist than western white pine. The following mountain ranges are areas where whitebark pine seeds can be transferred. The seeds can be transferred within the listed mountain range, but not across the ranges.

1. Sierra Nevadas (Region 5, R5)
2. Cascades (R6)

3. Selkirk and Cabinets (R1)
4. Clark Fork to Lolo Pass (R1)
5. Missions east to Glacier Park (R1)
6. Central Montana, except Yellowstone Park (R1)
7. Greater Yellowstone/Grand Tetons (R1, R2, and R4)
8. Bitterroots/to Idaho Plateau (R1, R4)
9. If outside these zones (e.g., Nevada populations), local is always better.

Within a given mountain range, cones collected from natural stands with low blister rust infection levels should not be transferred to an area with high blister rust infection. As an example, whitebark pine cones collected on the Southern Zone of the Shoshone NF in R2 should not be outplanted in high infection levels that are more typical in the Greater Yellowstone/Grand Teton zone (i.e., Yellowstone Park). If cone collections or plantings occur on the border of one or more zones, there is a danger in getting too caught up in the absolutes of zonal boundaries. Because of zone boundaries, limited genetic information in this species, and problems associated with keeping seed viable in storage, Mahalovich recommends slightly broader seed transfer from point of origin (regardless of zone), with an emphasis on **utilizing seed collected from blister rust resistant trees**:

1 degree latitude +/- 50 miles
1 degree longitude +/- 50 miles
no restriction on elevation transfer

Again, these first-cut seed transfer guidelines will be revised once we have information on any meaningful patterns of genetic variation for adaptive traits, such as blister rust resistance.

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Whitebark Pine on the Idaho Panhandle:
Excerpts from a Planning Meeting

by

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The following is a brief summary of a meeting held in the Supervisors office of the Idaho Panhandle National Forest (IPNF) regarding the future direction of whitebark pine on that forest, with an emphasis on the situation in the Selkirks. The meeting was attended by 23 people representing most disciplines on the IPNF, plus additional folks from the Forest Health and Protection group in Missoula and researchers from Forestry Sciences Laboratory in Moscow, ID and the Fire Sciences Laboratory in Missoula, MT.

Meeting Objectives: To share information about the past, current status, and future trends of whitebark pine in the Region, and specifically the Selkirk crest, and to discuss possible strategies for restoration. This would include ideas about what might be done and how to fund activities.

Background: The meeting was initiated because of interest in a sudden jump in mortality in the Selkirk whitebark pine forests that was brought to our attention by Tim McConnell (FHP Missoula) who conducts aerial surveys for Region One. He has flown this area for 8 years, and noted a huge jump in red trees in the summer of 1999 due to mountain pine beetle mortality. He passed out a summary data sheet which showed over 5,000 dead trees on 7,000 acres in 1999 compared to about 500 trees on 500 acres the previous 3 years.

We know that mountain pine beetle was probably a major player in recycling whitebark pine stands in the past. The many stands of "grey ghosts" found on the IPNF attest to this. The mountain pine beetle epidemics would create large areas of fuels that would often result in wildfires, which would create perfect site conditions for the Clark's nutcracker to cache seeds, which would result in regenerating the stand. However, a combination of white pine blister rust killing regeneration and fire suppression has resulted in many of these stands converting to subalpine fir and spruce.

Current Status: Since this is the only area on the IPNF and one of the few in the Region where there are still intact stands of mature whitebark pine, major losses would be of real concern to us. Art Zack reported that the GAA efforts, which are very conservative, indicate that the IPNF has lost about 60 percent of whitebark pine area (from 12,500 to 5,000 acres). This is a very rough estimate. Lydia Allen inventoried 16,000 acres with a component of whitebark on the Kaniksu in her work with caribou. Art also found that over 92 percent of the whitebark pine in the IPNF is on the Kaniksu, and most of the is in the Selkirks.

The concern is that we have been slowly losing this important high elevation ecosystem. But if we are now losing a major part of the mature trees due to mountain pine beetle, the problem becomes even more critical. Based on Tim's aerial surveys, FHP personnel did some minimal ground checking and found not only areas with mostly red trees, but also some areas where more than 50 percent of

the green whitebark pine are currently attacked. This means we will see even more red trees next summer as these trees fade, and the trend may continue.

Can we control the beetle? Sandy Kegley (FHP) explained that we could protect individual trees from mountain pine beetle attack by spraying them with a common insecticide (Sevin). This may have some merit if we can find some rust resistant candidates that would be important sources of seed, but the logistics of getting to trees with poor access and needing to spray to 50-60 feet or more make this unlikely; in addition to possible NEPA concerns about spraying insecticides in unroaded areas. She also reported that we do have an attractant pheromone which might be used to trap beetles out of an area. This strategy has worked for other bark beetles, but has not been tested on mountain pine beetle in whitebark pine. Logistics of weekly trap maintenance and possible spill-over of beetles to green trees might make this strategy difficult to implement successfully.

How can we encourage regeneration of whitebark pine? Regeneration is almost exclusively due to caching of seed by the Clark's nutcracker which prefers burned areas for caching. There is concern that whitebark pine populations may get so low that the nutcrackers will go elsewhere and "forget" how to cache whitebark pine seed, or if they stay, all the seed will be needed just for food. Several people discussed a wide variation in observed regeneration in local burns. Even if we do get natural regeneration, there are concerns that much of it may be killed by blister rust. However, Ray Hoff (retired Moscow researcher) has found up to 40 percent resistant seedlings near stands with high levels of blister rust.

What about artificial regeneration? Aram Eramiun reported that the nursery has solved some of the storage and growing problems that were a major problem with whitebark pine initially. He has several seed lots, but they are not from rust resistant trees. Grafting can also work, so we might consider collecting scion wood from good candidate trees if mountain pine beetle is threatening to kill them before we can get a good cone crop. The last 2 years have been exceptionally good cone crops, so we may not have another one for some time. Mary Francis Mahalovich emphasized the need to identify rust resistant trees and then the need to cage the cones in order to give the seed a chance to mature before collecting them. She has some funds to begin testing some of this material for rust resistance.

Silvicultural Efforts: Bob Keane and others explained that some small projects to use prescribed fire are underway in the Bitterroot Mountains. The problem is that burning windows are very short, and burning in these areas is not a very high priority anyway (not a major fuels/safety issue). There is also a possibility that silvicultural cuttings might be possible in small areas, but this is not the answer for a landscape need.

Caribou concerns: Lydia explained that whitebark pine ridgetops are prime calving habitat, and that additional openings might be an asset to the caribou. She has also worked with the District personnel to develop silvicultural treatments for up to 700 acres in the Myrtle/Ball Creek project. However, NEPA and USFWS issues take time and money to complete.

Where do we go from here?

1. Brief the leadership team regarding the situation and the results of this meeting.

2. There was a general consensus that we need to get started on a restoration plan that would address all the issues discussed. A steering committee was selected to proceed with this.

3. Of primary concern is the identification and monumenting of rust resistant trees and monitoring their cone crops. This can be initiated in 2000 with district personnel and current funding, with training provided by FHP and genetics folks. When a good cone crop is detected, we will have to cage cones.

4. Get a better idea of the mountain pine beetle outbreak as this will help determine the urgency of some projects. FHP will take the lead in this.

4. Try to include some small projects in the Myrtle/Ball Creek project. *This will take line officer decision to make it happen.* Also possibility of getting something in Ball/Trout creek plans?

5. Start a rust screening program for seed as it is collected. Aram and Mary Frances are currently working with old seed lots, and may be able to add more as funding becomes available.

6. Make sure that whitebark pine get proper emphasis in the north Zone geographic area analysis (GAA). Not sure who will take the lead in this.

RESEARCH NEWS AND NOTES

Incidence of the Red Turpentine Beetle in Whitebark Pine: Preliminary Results

by

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The red turpentine beetle (*Dendroctonus valens Lec.*) is a non-aggressive bark beetle that occurs throughout most of the United States and parts of Canada and Mexico. This beetle seldom causes extensive tree mortality; however, trees it attacks are weakened and thus become susceptible to other mortality agents.

The red turpentine beetle prefers trees in the genus *Pinus*, especially those already weakened or stressed (Furniss and Carolin 1977). Often, the beetle infests fresh stumps left after harvesting operations, and will move into surrounding standing trees when population levels become high (Coulson and Whitter 1984).

The life cycle of the red turpentine beetle begins with a flight period in spring when temperatures are between 19 and 23 degree C (Pajares and Lanier 1990). Beetles may fly further than 10 miles in search of a suitable host tree (Smith 1961). On standing trees, attacks usually occur below six feet on the tree bole, and galleries proceed downward from the attack point (Smith 1961).

In September 1998, we began surveying bark beetle populations in whitebark pine restoration treatments at Beaver Ridge, ID. Beaver Ridge is located on the Powell Area of the Lochsa District, Clearwater National Forest. Whitebark Pine Restoration treatments on Beaver Ridge include a control, selection harvesting with and without prescribed burning, thinning with and without prescribed burning, and stand-replacing fire with and without thinning. Fire treatments had not yet been implemented at the time of our survey. For our survey, we used fixed plots established by scientists at the Fire Science Laboratory, Rocky Mountain Research Station in Missoula, MT. These were 1/10 acre circular plots. There were 10 plots per treatment, for a total of 70 surveyed.

Each plot was surveyed for the presence of bark beetles. All tree species were checked and all bark beetles found were identified. The red turpentine beetle was found to be most abundant in the selection harvest treatments. Most beetles were found in new stumps; however, several attacks were found on standing live whitebark pine. We believe this is the first documented record of red turpentine beetle attacking whitebark pine.

During the summer of 1999, we will begin collecting data to determine flight periods and estimate population levels for the mountain pine beetle (*D. ponderosae*), the Engelmann spruce beetle (*D. rufipennis*), the western balsam beetle (*Dryocetes confusus*), and the red turpentine beetle. The study will be conducted at Beaver Ridge, and at Bear Overlook, another whitebark pine restoration site.

This work will determine what threat bark beetles pose during and immediately after restoration treatments. For the red turpentine beetle specifically, we will assess if attacks on live standing whitebark pine, resulting from the buildup of the beetle in stumps, will indicate a need for management.

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Whitebark Pine Restoration Research: A Time to Burn

by

Robert E. Keane, The Fire Sciences Laboratory, Rocky Mountain Research Station, P.O. Box 8089, Missoula, MT. Ph: 406-329-4846, email: bkeane/rmrs_missoula@fs.fed.us

Finally, we had the mother of all prescribed burning years in whitebark pine forests this year in many parts of the northern Rocky Mountains. A prolonged, four week prescribed burning window, coupled with good smoke dispersion and well-prepared fire management officers, resulted in the prescribed burning of more acres in whitebark pine ecosystems than has ever been burned in all other previous years, combined. The long, warm, dry fall, coupled with a series of light frosts, created fuelbeds just right for prescribed burning in high elevation systems while the lower elevation forests were only in moderate fire danger. Presented here is a summary of the burning that took place in and around the Bitterroot Mountains of Idaho and Montana as part of the research project Restoring Whitebark Pine Ecosystems (RWPE). This is not an extensive list of this year's whitebark pine prescribed burning, only the burns associated with the research project.

Musgrove Study Site, Cobalt District, Salmon-Challis National Forest -- Winds were light from the southwest and relative humidity was in the low 20's when Breck Hudson, silviculturalist and FMO-in-training, gave the order to start lighting the top of this 80+ acre unit. This 8900 ft elevation site was selected for study because it was experiencing severe encroachment of subalpine fir into dead and dying whitebark pine forests. Blister rust and beetles were not observed on this site, only advanced stages of succession. The prescribed burn was hot, primarily because of the high fuel loadings (> 60 tons/acre), low relative humidity, and low fuel moistures (1000 hr fuels around 10-15 percent), but stayed within the boundaries for most of the day. Flame lengths were sometimes twice the height of the canopy (> 100 ft) and the fire visited nearly all parts of the unit (>90 percent

coverage). The burn met most of its objectives by killing over 90 percent of the subalpine fir and reducing fuels with over 80 percent consumption. However, the fire killed nearly all cone-bearing whitebark pine trees within the burn boundaries and the fire did spot outside the unit and burned an additional 5 to 10 acres (including my control plots). Unbelievably, Clark's nutcrackers were observed intensively caching seeds into the burn unit only three days after ignition.

Beaver Ridge Study Site, Powell Work Station, Locsha Ranger District, Clearwater National Forest -- This study site is, by far, the most extensive of the RWPE research project with eight treatment units comprising over 400 acres. Chris Ourada and Joel Kemm lit the the first unit on September 22, 1999 and started the first of, hopefully, many whitebark pine prescribed burns on the Clearwater NF. This unit was a 40 acre mixed fir, lodgepole and whitebark pine stand where they had augmented the fuelbed by slashing small subalpine fir trees. The fire carried through the stand amazingly well considering the lack of fine fuels (> 1 ton/acre). Winds were light but gusting to 10 mph by mid-day while relative humidity hovered in the mid-to high 30's. Fire visited about 30 to 60 percent of the unit with flame lengths averaging 2-5 feet on the ground surface. Many firs experienced crown fires, but there were very little control problems. The next day, Chris and Joel lit another, larger (80 acre) unit, that had been cut to create "nutcracker openings" (i.e., small openings were every tree is removed except for healthy whitebark pine). These burned quite well and much hotter than the previous day. There were some control problems on this burn when the fire breached the unit boundary and started burning another research unit, but it was quickly contained. Later on in the fall they tried to light the remaining units but high fuel moistures and low temperatures prevented the fire from burning much of the stand.

Bear Overlook Study Site, Stevensville Ranger District, Bitterroot National Forest -- The top of this study area had been burned in the previous year (1998) so there was good black line around most of the top. About 2 hours after initial ignition, a small rain squall dampened the fuels and our spirits and thereby ended the prescribed burn in 1998 (see Nutcracker Notes issue 10). So, all Bruce (Buster) Windhorst and Mitch Kearns had to do was pick a date the next year and light the rest of the unit since the top part was already burned. This happened on October 4, 1999. The day was clear but cold (40-60 degrees F), winds were light but gusty, and relative humidities were in the low 30 percents. There had been a light dusting of snow on the unit about 5 days previous, so many of the fine and coarse fuels were still somewhat damp (1000 hr fuels 15-25 percent) but in prescription. As a result, the fire was also light, visiting only 10 to 40 percent of area in the unit with flame lengths of 1 to 3 feet. The ignition crew often had a difficult time keeping the strip headfires lit because the fire could not propagate in the moist shrubby fuelbed. However, this type of fire behavior was probably quite common in upper subalpine stands of the Bitterroot prior to European settlement. Overall, the burn was a success in that it met some objectives of fuel reduction and had patches of high fir mortality.

The Whitebark Pine Ecosystem Foundation:
A New Idea for Funding Restoration Efforts

by

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One of the most creative ideas to surface during the wrap-up session of the 1998 whitebark pine conference was the concept of forming a cooperative for whitebark pine management and conservation (see issue 10 of Nutcracker Notes). The group at this session envisioned the cooperative to be a collection of private organizations and public agencies organized to provide assistance and funding for whitebark pine restoration efforts. There are many examples of successful cooperatives established for special land management applications. The Montana Riparian Cooperative established by Drs. Robert Pfister and Paul Hansen provided timely research and technology transfer materials for riparian ecosystem management. The Inland Northwest Growth and Yield (INGY) Cooperative privately funds research and management projects in forestry and mensuration. Cooperatives are formed when the task at hand is too large or too specialized for any one organization or agency to fund, and the issues facing the manager are not well funded or supported by the organization. It was felt that whitebark pine restoration efforts could be best served by forming a cooperative or foundation to gain synergy and support for the vast array of potential and current whitebark pine projects.

In the winter of 1999, several researchers and managers met several times to discuss what it would take to form such an organization. Out of these meetings was born the ***Whitebark Pine Ecosystem Foundation (WPEF)*** and, over the course of the spring and summer, they crafted a the following charter for the WPEF:

Whitebark Pine Ecosystem Foundation

Purpose: The Whitebark Pine Ecosystem Foundation (WPEF) will be a cooperative organization for funding education, research, and restoration projects in the high-mountain ecosystems where whitebark pine functions as a keystone species.

Mission Statement: WPEF will promote the conservation of whitebark pine ecosystems by supporting educational, management, and research projects that enhance knowledge and stewardship of these valuable ecosystems. *Through the cooperative organization of WPEF, we will be able to do together what we cannot do alone*.

Background: Whitebark pine is a distinctive and critically important tree of high mountain ecosystems in western North America. Its large nut-like seeds are a high-quality food for many species of birds and mammals and its ecosystems are an important component of mountain landscapes. Whitebark pine ecosystems are primary catchment zones for late-lying snowpack and their condition is important for water quality and watershed protection.

Whitebark pine's varied and picturesque growth forms and its scenic habitat also provide a unique aesthetic experience for visitors to this high mountain ecosystem. Although whitebark pine is normally a long-lived tree, in recent decades it has suffered heavy mortality as a result of the introduced disease, white pine blister rust. Whitebark pine is also being replaced successionally by shade-tolerant trees as a result of suppression of natural fires. Few attempts have been made to restore declining whitebark pine ecosystems because of the low level of awareness of their values and of their damaged condition. Also, while recent, small restoration projects show promise, there is inadequate information and experience and a lack of funding to support restoration at any significant scale. Being remote and having little value for timber production, whitebark pine ecosystems have received scant attention from forestry institutions. WPEF will correct these deficiencies by obtaining and disseminating critical knowledge for ecological restoration and also by supporting restoration activities.

Objectives and Goals: WPEF will promote understanding and appreciation of both the high value and the damaged condition of whitebark pine ecosystems. WPEF's primary goal is to support the conservation and restoration of these ecosystems. This will be accomplished by (1) informing and educating the public and natural resource agencies of the values of whitebark pine ecosystems and threats to their perpetuation, (2) supporting research that provides understanding of whitebark pine ecosystem processes and functions, and investigates and tests possible strategies for restoration, and (3) providing financial assistance and technical support for restoration efforts. Monies to accomplish these objectives will be solicited from environmental foundations, ecological organizations, the public at large, and government agencies.

Organization: WPEF will consist of a Steering Committee composed of one member from each contributing organization or government agency. The Steering Committee sets policy and direction for the Foundation, and approves budgets and work plans. The Steering Committee elects a chair. Day-to-day activities of the Foundation will be conducted by the Executive Committee composed of a director, assistant director, and a secretary-treasurer. The director shall serve at the pleasure of the Steering Committee and will function as the manager of the Foundation. The director can serve as a non-voting member of the Steering Committee. The Executive Committee may need to create new positions as WPEF grows in structure and popularity because it will be responsible for membership and fund raising projects. A Selection Committee of 5 to 7 members appointed by the Steering Committee will evaluate all proposals and projects for possible funding. Other committees can be added as needed. Each committee meets at least once a year.

Membership: All individuals, organizations and government agencies are encouraged to join. A minimum fee of $1,000 per year is needed for full (voting) membership and a place on the Steering Committee. However, anyone can donate any amount to the foundation. To encourage donations, WPEF will seek formal tax-exempt status. *Nutcracker Notes*, the news digest of activities in whitebark pine research and management, will be expanded and improved to serve as a vehicle for communication and outreach by WPEF. Each member can

submit a mailing list for distribution of *Nutcracker Notes*.

Needs: There are many immediate demands required of WPEF. Listed below is a set of pressing needs that WPEF can uniquely address.

1. Encourage and support restoration activities in whitebark pine ecosystems through outreach and providing supplemental funding.

2. Develop and deliver educational tools for communicating information about the values of whitebark pine ecosystems and their restoration needs;

3. Provide vehicles (newsletter; web site; conferences, etc.) that serve as a forum for whitebark ecosystem research and management concerns;

4. Identify research needs for whitebark pine restoration, and

5. Garner financial support from government agencies and public groups.

Justification: WPEF will serve as a vehicle for reviewing and funding restoration projects in whitebark pine ecosystems. It is very difficult for land management agencies to provide objective, expert review of potential restoration projects in whitebark pine ecosystems. Moreover, funding in most agencies are tied to a specific year and it is often difficult to carry monies over to the next fiscal year. This funding method is incompatible with ecosystem restoration in whitebark pine because suitable prescribed burning conditions do not occur every year. WPEF will provide the expertise, personnel, and administration to allocate monies to the most meritorious restoration projects. This will effectively link funding from a variety of sources to accomplish the foundation's objectives: educate, support, and provide assistance for ecosystem restoration. WPEF will serve as the clearing house to disseminate information, expert advice, and financial support for conservation and restoration of whitebark pine ecosystems.

At the present, the interim officers of this foundation are: Steve Arno (Director), Kate Kendall (Vice-Director), and Bob Keane (Secretary-Treasurer). Once this organization has started, elections will be held to determine the next set of officers. Currently, Arno and I have been doing the paperwork to get the WPEF a tax-exempt, non-profit (501-3c) status. We have also got the foundation a mailbox (P.O. Box 135, Missoula, MT 59806) and a checking account. We will try to solicit funds from government agencies and private individuals sometime in early 2000. We would appreciate any comments and help in organizing the foundation and look forward to its long and healthy life.

WHERE THE RUBBER MEETS THE ROAD
Whitebark Pine Success Stories

Planned projects: The **Flathead National** Forest Tally Lake Ranger District (Bryan Donner) has just completed NEPA on the Werner Peak Whitebark Pine Restoration Project near Werner Peak along the Whitefish Divide Mountains where about 95 acres will be burned to reduce fuels and promote whitebark pine regeneration. **Lewis and Clark National Forest**, Rocky Mountain RD (Brad McBratney) is still planning a 50,000+ acre burn mostly in lodgepole pine but some whitebark pine sites will also be burned.... **Kootenai National Forest**, Murphy Lake RD, (Mike Liu) is still planning a large prescribed fire in the Ten Lakes Primitive Area to create habitat for whitebark pine regeneration. Some of this area burned in a wildfire and effects have not yet been measured. **Clearwater National Forest**, Loscha RD (Jon Weston, Chris Ourada) is implementing whitebark pine restoration cutting and burning in a mixed fir-mountain hemlock stand at the Blacklead project area.

Accomplishments: **Salmon-Challis National Forest**, Cobalt RD, (Breck Hudson, Barbara Levesque, Diane Schuldt) burned over 80 acres in at the headwaters of Musgrove Creek fire to increase the regeneration success of whitebark pine and increase the vigor and health of existing whitebark pine stands. The **Clearwater National Forest,** Loscha RD burned over 100 acres in whitebark pine on their restoration project at the Beaver Ridge Study site. The **Bitterroot National Forest** burned over 70 acres of whitebark pine at the Bear Overlook study area on the Bitterroot Divide. **Banff National Park, Canada** (Robert Walker) burned about 12 ha of high elevation site in a whitebark pine restoration project.

(*Editors Note: You are encouraged to send the editor a short summary of any research project you have planned or implemented recently. Send to bkeane/rmrs,missoula on IBM 615 or bkeane/rmrs_missoula@fs.fed.us via Email to IBM 615*)

WHITEBARK TIDBITS

Cone Crops Corps. This was an odd year for whitebark pine cone production. Good to bumper cone crops were reported nearly everywhere except for parts of southwestern Montana and eastern Idaho. This is strange because last year, 1998, was also a good to bumper cone crop around the region. It is rare to have two good cone years back to back. Casey Teske, RMRS Fire Lab, reports moderate to good crops in the Seven Devils of Idaho. Breck Hudson of the Salmon-Challis NF reports one of the best cone crops in the whitebark pine near the Big Horn Crags and Blackbird Mountain. A good cone crop was also observed in the Bitterroot mountains, Gallatin Range, Swan Range, Big Hole Mountains, and on many parts of the Beaverhead-Dearlodge National Forest. Dave Spildie, Aldo Leopold Wilderness Research Institute, noted a large cone crop on whitebark pine in the Sierra Nevada range of California.

Warning, Warning, Warning. This will be last issue of ***Nutcracker Notes*** that will be free of charge and distributed on the internet. The Whitebark Pine Ecosystem Foundation will take over the publication of the ***Nutcracker Notes*** and will print it on glossy paper and disperse by snail mail. The subscription purchase price: simply the membership fee of the foundation, which will be announced later.

Suddenly Seeking Ribes. Mary Mahalovich would like to ask your assistance in collecting seeds and/or cuttings of specific Ribes species to establish a *Ribes* garden at Lone Mountain TIA for work being done on whitebark pine. The following species are typically found in the whitebark pine zone: *Ribes* lacustre, R. viscosissimum, and R. montigenum. Plant material contributions would be greatly appreciated. Please send seed or cutting collections to the Coeur d'Alene Nursery, in c/o Aram Eramian. Please contact Aram directly for instructions (time of year, labeling, shipment, quantities, etc.) of the different types of plant material.

Canadian Restoration, eh. Robert Walker, Fire and Vegetatin Specialist for Parks Canada, Radium Hot Springs, BC mentions they are establishing research transects in prescribed burning sites in several national parks including Waterton, Banaff, and Yoho. He mentions the difficulty on convincing management and the publics that whitebark pine is an important natural resource issue. Once he garners support, he plans to develop an off-site breeding program similar to the one just starting in the US.

Da Book. Many have asked when the proceedings from the 1998 symposium will be published. As most of you know, the proceedings are actually being published as a book by Island Press. This book, edited by Diana Tomback, Steve Arno, and Bob Keane, is currently in its last stages of editing. The final chapters will be sent to Island Press sometime in January or February 2000. We expect the book to be published sometime late fall or early winter 2000. Those who registered the symposium will have their books mailed to them at no cost. Others will have to order from Island Press.

PUBLICATION AND EVENTS ALERT

Current Publications

Campbell, E. 1998. Whitebark pine forests in British Columbia: composition, dynamics, and the effects of blister rust. M.Sc. Thesis. University of Victoria, Victoria B.C. 136 pages.

A vignette from this thesis was presented in the last issue of NUTCRACKER NOTES (Number 10). Campbell=s findings are very interesting in that the rust doesn=t seem to have caused as much mortality in British Columbia as it has south of the border. She also has some excellent ideas on whitebark pine community relationships.

Donnegan, J.A. and A.J. Rebertus. 1999. Rates and mechanisms of subalpine forest succession along an environmental gradient. Ecology 80(4):1370-1384.

This paper looks at succession gradients in limber pine, not whitebark pine, forests. Succession proceeds from limber pine to Engelmann spruce. Interesting parallels with whitebark pine in that AClark=s nutcrackers catalyzes early succession by caching pine seeds in extensive burns, many of which germinate to form multi-growth forms≅.

Feldman, R., D.F. Tomback, and J. Koehler. 1999. Cost of mutualism: competition, tree morphology, and pollen production in limber pine clusters. Ecology 80(1):324-329.

The authors found that, because seeds stored in clusters represent potential direct fitness loss to parent trees, nutcracker caching behavior may be suboptimal for limber pine at late stages, thereby indicating a possible Acost of mutualism≅ with respect to genetics.

Howard, Janet. 1999. Transplanted whitebark pine regeneration: the response of different populations to variation in climate in field experiments. MS Thesis. University of Montana, School of Forestry, Missoula, MT. 38 pages.

Janet planted seeds collected from four sites of varing rust mortality on three environmentally different sites and monitored survivorship,growth, biomass, and carbon isotope discrimination. An interesting finding was the performance of transplanted populations was not correlated with site of origin. Very interesting findings with great implications for rust resistance breeding in natural populations.

Koteen, L. 1999. Climate change, whitebark pine, and grizzly bears in the Greater Yellowstone Ecosystem. Phd dissertation, Yale School of Forestry.

This disseration is being evaluated for inclusion in a book on climate change and ecosystems. It presents several scenarios under climate warming where the rust will increase in intensity and infection and do further damage to whitebark pine, especially in the Greater Yellowstone Ecosystem. Interesting reading.

Murray, M.P., S.C. Bunting, and P. Morgan. 1998. Fire history of an isolated subalpine mountain range of the Intermountain Region, United States. Journal of Biogeography 25:1071-1080.

Murray extensively sampled the west Bighole Range separating Montana and Idaho and found disparities in fire size and burn severity depending on the side of the mountain range. Since the 1870's, area burned has decreased by 87 percent. Typically, fires in this range were small but frequent as evidenced from landscape pattern and fire scar analysis. This study has major implications for the future of whitebark pine in small linear mountain ranges where all fires are actively suppressed.

Rogers, D.L., C.I. Millar, and R.D. Westfall. Fine-scale genetic structure of whitebark pine (Pinus albicaulis): Associations with watershed and growth form. Evolution 53(1):74-90.

This genetics study was conducted in the eastern Sierra Nevada Range of CA. They found that genetic differentiation among three topographically different watershed populations was Avirtually negligible.≅ The greatest genotypic variation was in the direction of the prevailing wind. They concluded genetic structure was profoundly affected by the seed caching behavior of the nutcracker, and genetic variation is highly structured, especially in natural groupings such as thickets.

Schmitt, C.L. and D.W. Scott. 1998. Whitebark pine health in northeastern Oregon and western Idaho. USDA Forest Service Wallowa-Whitman National Forest, Blue Mountain Pest Management Zone BMZ-99-03. 11 pages.

This report outlines the results of an informal survey of walkthru exams on number of sites in OR and ID. The authors found mountain pine beetle and rust mortality light to severe at the sites. Blister rust occurs throughout northestern OR and the health of the stands has been worsened byfire exclusion.

Smith, J. And J. Hoffman. 1998. Status of white pine blister rust in Intermountain Region white pines. USDA Forest Service Forest Health Protection Report No. R4-98-02. Intermountain Region State and Private Forestry, Ogden, UT.

Jim Hoffman passed this report around at the symposium. White pines were surveyed at 100 sites in Region Four and significant increases in rust incidence and intensity were measured. Of interest is the increase in rust on the Payette, Targhee, Boise, and Sawtooth National Forests, and also in Yellowstone. The abstract for this report appears in this issue of Nutcracker Notes.

Tomback, D.F. 1998. Clark=s Nutcracker (*Nucifraga columbiana*). IN: The birds of North America, No. 331. A. Poole and F. Gill editors. The Birds of North America, Inc., Philadelphia, PA.

This is a comprehensive summary of all current information on the Clark=s Nutcracker. This paper discusses every aspect of the bird from breeding to nesting to population demography and lastly to conservation. A real Amust≅ for those interested in this invaluable bird.

WHITEBARK PINE WEB SITE

Kate Kendall and Marilyn Blair continue to maintain and organized a darn fine web site for all whitebark pine information. Its address is:

http://www.mesc.usgs.gov/glacier/whitebar.htm

The web master, Marilyn Blair, has also reformatted all past NUTCRACKER NOTES and placed them at their own web site. The address to get to current and past issues of Nutcracker Notes is:

http://www.mesc.usgs.gov/glacier/nutnotes.htm

This site contains all the previous ten issues of Nutcracker Notes (Numbers 1 thru 10), and will contain this issue soon.

Editors Page

NUTCRACKER NOTES is a vehicle for the dispersal of information on all facets of whitebark pine ecosystems. Summaries of research results and management projects in whitebark pine forests are presented to provide readers state-of-the-art information. The purpose of this newsletter is to distribute timely information so that land managers and scientists can understand and deal with important ecological issues in the whitebark pine ecosystem. Issues of NUTCRACKER NOTES will be numbered consecutively and published 1-3 times a year depending on available material.

Submission of Articles: Everyone is invited to submit articles to NUTCRACKER NOTES. These articles should be mailed to Nutcracker Notes, c/o Bob Keane, Rocky Mountain Research Station, Intermountain Fire Sciences Lab, P.O. Box 8089, Missoula, MT 59807. If possible, they should be submitted electronically *(*Send to *bkeane/rmrs,missoula* on USFS IBM 615 or *bkeane/rmrs_missoula@fs.fed.us* via Email to USFS IBM 615*)* or written to a floppy disc (WordPerfect text processing) and then mailed. You are encouraged to submit articles to improve this valuable information network.

Newsletter Format: Articles submitted to NUTCRACKER NOTES will be presented in the newsletter under three main categories: Management News and Notes, Research News and Notes, and Publication and Events Alert. Management News describes current activities, problems, observations, conditions planned or implemented by land management agencies in whitebark pine forests. Research News describes current or planned research projects in these ecosystems. Publication and Events Alert is simply a list of current events and published information that may be of intserest to readers of the newsletter. The reader will find a complete all authors addresses and email addresses accompanying each article. There will usually be an editorial at the beginning of the newsletter to highlight important topics and provide a forum for opinions. There are also the short features that allow you to send the editor snippets of information about projects in your area.

Errata and omissions: None as yet.

Bob Keane, Editor